PESTICIDE PUBLICATION

PB 279 181

73

Reprinted from the A. M. A. Archives of Industrial Health
January 1960, Vol. 21, pp. 7-9
Copyright 1960, by American Medical Association

Environmental Protection Agency
Athens, Georgia 30601

Effects of DDVP Aerosols on Blood Cholinesterase of Fogging Machine Operators

ROBERT F. WITTER, Ph.D., Savannah, Ga.

0,0-Dimethyl-2,2-dichlorovinyl phosphate (DDVP) has been found to be very effective in the control of the cigarette beetle in tobacco warehouses.[1] One method of application is to blow the volatile insecticide into the building from a Todd Insecticidal Fog Applicator (TIFA) placed outside the warehouse. Although the toxicity of DDVP has been studied,[2] no investigation has been made of the effect of the above operations on the health of the men who operate these machines. Such studies are presented in this report. Since DDVP is an organic phosphate insecticide and readily inhibits blood or plasma cholinesterase,[3] it was possible to ascertain the possible exposure of these men to the insecticide by measurement of the level of these enzymes in the blood. In addition, each man was given a periodic physical examination in order to determine whether symptoms characteristic of poisoning with organic phosphate compounds had appeared.

Methods

The 12 men studied in this survey each worked a total of 45 hours a week for four months applying insecticides, except for Nos. 8 and 11, who operated the fogging machines for only two months. Work with DDVP was begun just after May 7, 1958. These workers applied 4% DDVP for eight hours a day on Monday and Thursday and a mixture of 3% lindane and 2% DDT in deodorized oil base on Tuesday, Wednesday, and Friday. The rate of spraying of both formulations was approximately 9 gal. per hour. Three of the men (Nos. 1, 2, and 7) formulated the DDVP insecticide by mixing 1 lb. of technical DDVP with 1 lb. of ethylene dichloride and 3 gal. of Bayer D. These persons wore protective rubber clothing, rubber gloves, and industrial-type gas masks during the formulating procedure. The men did not wear protective clothing or masks while operating the fogging machines but were instructed to stay on the windward side of the equipment during operation in order to minimize exposure to the DDVP aerosol.

The workers probably received their greatest exposure to the insecticide when the machine was started up or stopped, because at that time they had to get closer to the point of application of the aerosol. Also, since it was not always possible to stay on the windward side of the equipment, exposure was sometimes increased by this circumstance. Occasionally a man would enter the warehouse for three to five minutes after the DDVP was applied. None of the men changed clothing before leaving the plant.

Each month the men were given a physical examination, and at the same time a blood sample was taken for cholinesterase assay by the Michel procedure.[4]

Results and Conclusions

The physical examination gave no evidence of neurological symptoms which might be associated with the inhibition of cholinesterase by DDVP or with poisoning with DDT or lindane. The cholinesterase levels in the blood of these applicators were not decreased during the period of exposure. The results indicate that no physiologically significant exposure to DDVP took place.

Under the conditions of this study, the chlorinated hydrocarbons with which the men came in contact would not be expected to influence the levels of blood cholinesterases. The titer of plasma cholinesterase remains unchanged in men with very high occupational exposure to DDT.[4] It is true that the level of serum aliesterase is ele-

Received for publication May 18, 1959.

From the Technical Development Laboratories of the Communicable Disease Center, Bureau of State Services, Public Health Service, U.S. Department of Health, Education, and Welfare.

3

vated in rats exposed to various chlorinated hydrocarbon insecticides, but the dosages used with the animals were high enough to produce clinical symptoms of poisoning.[5,6]

In some other studies with applicators who worked under different conditions and with organic phosphorus compounds different from those in the present survey, it was found that the cholinesterase levels of the blood of these spray operators gradually became lower as the spray season progressed.[7-10] Although the results are somewhat variable, it can be seen in the Table that this was not the case in the present study. It appears from these results that the procedure used for the application of DDVP presents no hazard from the insecticide to the men operating the Todd Insecticidal Fogging Applicator over a four-month period, providing these machines are properly used.

Summary

The levels of blood cholinesterases were studied in men who used Todd Insecticidal Fogging Machines to apply 4% 0,0-dimethyl-2,2-dichlorovinyl phosphate (DDVP) aerosols for 16 hours a week to tobacco warehouses. No decrease in the concentration of the plasma or red blood cell enzyme was found over a period of four months. It is concluded that this method of application of DDVP does not constitute a hazard to the health of these workers, providing the fogging machines are properly used.

Mr. Charles M. Sprinkle, Coordinator of Agricultural Research, R. J. Reynolds Tobacco Company, Winston-Salem, N. C., assisted in this study. The physical examinations were done by Dr. R. W. Bunn, Medical Director, R. J. Reynolds Tobacco Company. Miss Louise McLeod, Histopathology Technician of the Technical Development Laboratories, determined the plasma and red blood cell cholinesterase levels.

U. S. Department of Health, Education, and Welfare.

REFERENCES

1. Tenhet, J. N.; Bare, C. O.; Childs, D. P., and Durham, W. F.: Studies of DDVP for Control of Cigarette Beetles in Tobacco Warehouses, U.S. Department of Agriculture, Agricultural Marketing Service, Marketing Research Division, AMS-214 November, 1957.

2. Durham, W. F.; Gaines, T. B.; McCauley, R. H., Jr.; Sedlak, V. A.; Mattson, A. M., and Hayes, W. J., Jr.: Studies on the Toxicity of 0,0-Dimethyl-2,2-Dichlorovinyl Phosphate (DDVP), A.M.A. Arch. Indust. Health 15:340 (April) 1957.

3. Michel, H. O.: An Electrometric Method for the Determination of Red Blood Cell and Plasma Cholinesterase Activity, J. Lab. & Clin. Med. 34: 1564 (Nov.) 1949.

4. Ortelee, M. F.: A Study of Men with Prolonged Intensive Occupational Exposure to DDT, A.M.A. Arch. Indust. Health 18:433 (Nov.) 1958.

Plasma and Red Blood Cell Cholinesterase Levels of DDVP Applicators

	Date Blood Sample Taken									
	May 7 *		June 4		July 7		Aug. 5		Sept. 5	
Applicator	R B C †	Plasma †	RBC †	Plasma †	RBC †	Plasma †	RBC †	Plasma †	RBC †	Plasma †
1	0.84	1.06	0.83	1.14	0.83	1.05	0.95	0.91	0.97	0.90
2	0.55	0.86	0.69	0.79	0.82	0.87	0.77	0.72	0.69	0.79
3	0.61	0.36	0.91	0.47	1.00	0.56	0.80	0.52	0.98	0.44
4	0.71	0.85	0.92	1.06	1.10	1.25	0.86	1.04	1.05	0.92
5	0.66	1.08	0.75	1.30	0.89	1.21	1.02	1.24	0.86	1.24
6	0.64	1.18	0.87	1.22	0.86	1.17	—	—	0.84	1.14
7	0.80	1.08	0.84	1.20	1.01	1.16	0.82	1.20	0.84	1.10
8	0.80	0.60	0.76	0.74	1.02	0.69	—	—	—	—
9	0.48	1.01	0.76	1.25	1.22	—	0.75	0.97	0.85	1.24
10	0.44	0.82	0.71	0.89	0.88	1.00	—	—	0.77	0.79
11	—	—	—	—	0.76 *	0.80 *	0.82	0.90	0.88	0.94
12	0.43	1.17	0.67	1.33	1.10	1.25	—	—	0.88	1.18

* Preexposure levels.

† Δ pH per hour per 0.02 ml. of packed cells or plasma.

5. Ball, W. L., and Kay, K.: Serum Esterase Activity as a Criterion of the Toxicity of Chlorinated Hydrocarbon to Rats A.M.A. Arch. Indust. Health 14:319 (Oct.) 1956.

6. Crevier, M.; Ball, W. L., and Kay, K.: Observations on Toxicity of Aldrin: II. Serum Esterase Changes in Rats Following Administration of Aldrin and Other Chlorinated Hydrocarbon Insecticides, A.M.A. Arch. Indust. Hyg. 9: 306 (April) 1954.

7. Culver, D.; Kinosian, J.; Thielen, W., and Graul, R.: A Study of Exposure to Parathion in a Greenhouse, A.M.A. Arch. Indust. Health 18: 235 (Sept.) 1958.

8. Hayes, W. J., Jr.; Dixon, E. M.; Batchelor, G. S., and Upholt, W. M.: Exposure to Organic Phosphorus Sprays and Occurrence of Selected Symptoms, Pub. Health Rep. 72:787 (Sept.) 1957.

9. Kay, K.; Monkman, L.; Windish, J. P.; Doherty, T.; Pare, J., and Racicot, C.: Parathion Exposure and Cholinesterase Response of Quebec Apple Growers, A.M.A. Arch. Indust. Hyg. 6: 252 (Sept.) 1952.

10. Sumerford, W. T.; Hayes, W. J., Jr.; Johnston, J. M.; Walker, K. and Spillane, J.: Cholinesterase Response and Symptomatology from Exposure to Organic Phosphorus Insecticides, A.M.A. Arch. Indust. Hyg. 7:383 (May) 1953.